

AFROSAI-E

Maintenance of assets

Performance Audit Guidelines



African Organisation of Financial Institutions

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Maintenance of assets - Performance audit guidelines

Preface

AFROSAI-E has declared performance auditing as a strategic imperative and decided on an ambitious goal for the development of performance auditing within the region. AFROSAI-E will achieve this by supporting our member SAIs with template manuals, guidelines, training, production of training material, website development, quality assurance visits, etc.

The General Auditing Standards of INTOSAI¹ stipulate that each supreme audit institution (SAI) should adopt policies and procedures to prepare manuals and other written guidance and instructions concerning the conduct of audits. AFROSAI-E has developed a template manual on performance auditing. As a continuation of this work, AFROSAI-E has decided to develop guidelines for specific audit problem areas that are often the object for performance audits. The guidelines on performance auditing of maintenance are the second in this series.

The guidelines were developed by a working group consisting of Mr. Fredrik Friberg and Mr. Jan Vikström from our institutional partner, the Swedish National Audit Office, in cooperation with Mr. Bengt Sundgren at the AFROSAI-E Secretariat. The working group has visited the SAIs of Botswana and Uganda to collect the experiences from these SAIs' work on maintenance audits. A draft version of the guidelines was commented on by the SAIs of Botswana, Ghana and Uganda. Several experienced performance auditors in the region have also given their comments on the draft.

I hope these guidelines will assist our member SAIs when carrying out performance audits on maintenance. If you have feedback on the guidelines or suggestions for new topics in these series of guidelines you are welcome to contact the AFROSAI-E Secretariat.

M W Pretorius
Executive Officer
AFROSAI-E Secretariat

¹ International Organisation of Supreme Audit Institutions. ISSAI 200 "General standards in Government Auditing and standards with ethical significance", Chapter 1.2 (c).

Contents

Preface	2
1 Introduction	4
1.1 Purpose of the guidelines	4
1.2 Structure of the guidelines	4
2 Definition of maintenance and scope of maintenance audits	4
2.1 What is maintenance?	4
2.2 What is significant with a performance audit regarding maintenance issues? 5	
2.3 Why carry out performance auditing on maintenance?	5
2.4 Maintenance and the three E:s	6
3 How to carry out performance audits on maintenance	7
3.1 The performance audit process	7
3.2 Selecting an audit problem	7
3.3 Audit objective, scope and audit questions.....	12
3.4 Assessment criteria	13
3.5 Approaches and methodology	14
4 Experiences from SAI's in the region	17
4.1 Experience from audits of different types of assets	17
4.2 Findings and conclusions on maintenance	19
Annexure 1: Maintenance in relation to surrounding problems	21

1 Introduction

1.1 Purpose of the guidelines

The purpose of the guidelines are to provide guidance when conducting performance audits on maintenance of assets. The guidelines describe the conceptual underpinnings of maintenance audit methodology, explaining in broad terms how these audits can be selected, planned and conducted. In addition, the guidelines provide an overview of lessons learnt of some audits on maintenance that have been carried out within the region. Users are referred to the AFROSAI-E Template Performance Audit Manual for detailed explanations of key concepts used in performance auditing.

1.2 Structure of the guidelines

In addition to chapter 1, the guidelines consist of three chapters and one appendix:

- Chapter 2 deals with the definition and context of maintenance and defines the characteristics of performance auditing on maintenance.
- Chapter 3 is focused on how to carry out performance audits on maintenance issues.
- Chapter 4 gives experiences from performance audits of maintenance done by SAI's in the region.
- Appendix 1 contains a figure illustrating the maintenance process as related to potential problems.

The guidelines present a number of practical examples. These examples are mostly based on real audits. To clarify and highlight difficult issues the content from the audits can have been slightly modified.²

2 Definition of maintenance and scope of maintenance audits

2.1 What is maintenance?

Maintenance is the combination of all technical, administrative and managerial actions during the life cycle of an asset intended to retain it in, or restore it to, a state in which it can perform the required function necessary to provide a given service. Maintenance aims to ensure that the asset continues to function and meet the required quality standards throughout its anticipated lifetime. Maintenance can also extend the life of the asset beyond the original "design life".

The main purpose of maintenance, in the context of public organisations, is to ensure effective service delivery to the public by ensuring that the auditee's assets are maintained at their best operational/service levels at minimum cost. Different users are directly dependent on well operated and maintained facilities, e.g. companies and public on using roads and are dependent on the distribution of water. Inadequate, or lack of maintenance, can have negative effects on the users.

There are three main types of maintenance: routine, periodic and emergency.

- *Routine maintenance* includes a range of normally small-scale activities to ensure the asset's continuous operation. During routine maintenance it may be possible to use unskilled labor or labor intensive methods.

² The original and other performance audit reports concerning maintenance issues of assets are also published on AFROSAI-Es web page, www.afrosai-e.org.za.

- *Periodic maintenance* occurs less frequently and is carried out at predetermined intervals or according to predefined criteria. It is normally large scale and often requires specialist equipment and skilled labor.
- *Emergency maintenance* is occasionally urgent, unplanned actions that are required, for example because of unexpected deterioration or damage of an asset or accidents by, for example severe weather conditions such as floods, or collisions.

The terms of these categories of maintenance could differ somewhat between countries and area of maintenance. In addition, the entity responsible for the maintenance of the asset might have more detailed schemes or definitions.

2.2 What is significant with a performance audit regarding maintenance issues?

Audits on maintenance issues deal mainly with assessing the need of maintenance activities, planning, managing, contracting out maintenance tasks, monitoring, and assessing the maintenance carried out. Such audits can also touch on skills and training aspects of the staff that carry out maintenance.

Auditing maintenance issues is a challenge since, e.g. infrastructure projects embrace long-life and often technically refined activities, thus continuous operation is inherently associated with adequate and long-term planning.

Performance audits of maintenance issues define some aspects of maintenance as the audit problem. Maintenance aspects could also be included as a part of an audit with a broader scope. If, for instance, a generic problem is an increase in traffic accidents, maintenance of the roads could be regarded as one aspect explaining the increase in traffic accidents.

The guidelines would be applicable to all types of maintenance but the references in these guidelines are – for reasons of the topics of performance audits carried out in AFROSAI-E – limited to maintenance of four types of assets:

- Buildings
- Roads
- Water supply systems (rural and urban)
- Vehicles

2.3 Why carry out performance auditing on maintenance?

There are good reasons to focus an audit on maintenance issues. Possible effects of inadequate maintenance are poor service delivery, low customer satisfaction, and high costs for the individual user due to the fact that the assets are not being properly used. The cost for the government can also be higher if the lifespan of the asset that the government has invested in is reduced.

Maintenance audits can be easy to motivate from a *materiality* point of view.³ Maintenance activities are often costly and can take a significant share of the state budget. The argument for having a functioning system for maintenance can be strengthened if the auditor during the audit compare the cost for the government for not having a functioning system for maintenance of assets compared with a functioning system. Shortcomings in maintenance can have a great impact on the living conditions of people (e.g. water supply). A well maintained infrastructure will stimulate growth in the economy (e.g. agriculture, roads); which in turn will increase

³ The reasons for conducting a performance audit on maintenance can be formulated in terms of selection criteria's presented in the AFROSAI-E Template Performance Audit Manual.

employment opportunities. Thus effective maintenance could play a role in poverty alleviation. Some examples of consequences deriving from poor maintenance are:

- Non-functioning facilities lead to poor service delivery.
- Leakages from poorly maintained water pipes lead to cross contaminated drinking water thus endangering life and health.
- Water from mines owned by governmental parastatals contaminates the ground water.
- Poor condition of roads jeopardizes vehicles safety, or causes delays, also in cases of emergency, for instance fire brigades.
- Roads and buildings deteriorate over a period of time and leave the road impassable and building inhabitable
- Poor standard of government buildings affect civil servants' working conditions and ability to perform well.
- Lack of maintenance leads to needs for new and costly investments in replacement of assets.

The *risks* involved are connected with value-for-money aspects. If, for example, assets are not maintained, minor maintenance problems tend to grow more serious and become more expensive to repair. The costs of maintenance can often be reduced by better evaluation of conditions, prioritisation of works and improved contracting.

2.4 Maintenance and the three E:s

A performance audit of maintenance often starts with an indication of shortcomings in the delivery of a specific performance of the auditees service delivery to the public. If the shortcomings can be derived from maintenance problem the auditors should focus on identifying the reasons for the poor maintenance.

The three E:s – economy, efficiency and effectiveness – serve as the basis for performance audits. Performance audits on maintenance will also cover one or more of these three concepts.

Economy = Minimising the cost of resources for an activity, having regard to appropriate quality.

If routine maintenance work is not done, there is a risk that the cost for emergency maintenance will be high. The assets will deteriorate and the long run costs to restore or replace the assets become much higher.

Efficiency = The relationship between output in terms of goods, services or other results, and the resources used to produce them.

If the assets are not operational because of a lack of maintenance the production and service delivery by the public entity will be low. The reasons for poor service delivery, derived from inadequate maintenance, are often to be found in flaws in planning, monitoring and controlling at the strategic and operational levels. Management has perhaps failed to develop needs assessment systems, prioritise objectives and choose strategies for maintenance activities. There can be a lack of systems to monitor that maintenance to see whether it has been done according to plan.

Effectiveness = The extent to which objectives are achieved and the relationship between the intended impact and the actual impact of an activity.

Those are problems which can be measured in terms of whether the audited entity has achieved its goals. Lack of maintenance could be one of several causes for the audited entity not achieving its goal. Audits of effectiveness problems might be, for instance that people do not obtain clean drinking water or that poor maintained

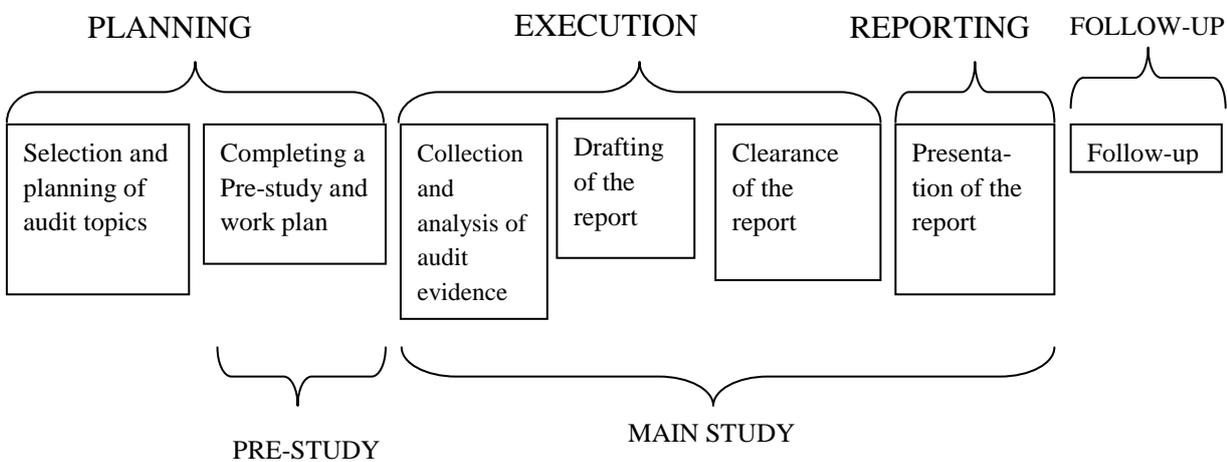
roads lead to a deteriorated roads network which hamper the transport of people and goods.

3 How to carry out performance audits on maintenance

3.1 The performance audit process

The performance audit process covers several phases. It comprises planning, execution (conducting the main study), reporting and follow-up. Each one of these phases can, in accordance with the AFROSAI-E Template Performance Audit Manual, be divided into different stages. This is demonstrated in the figure below.

Figure 1: The performance audit process



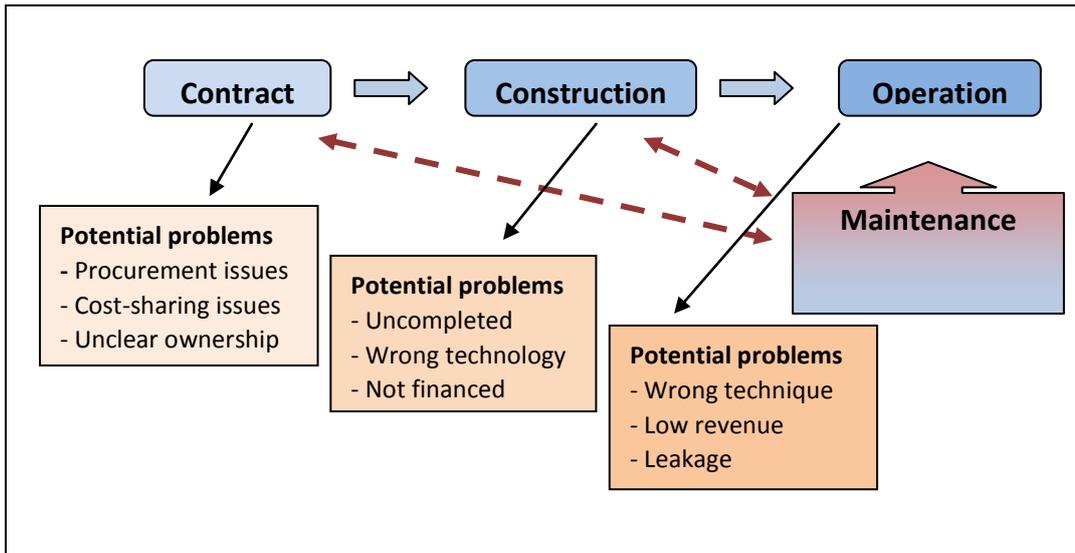
Chapter 3 focuses on the planning and execution stages where you need specific criteria and methods for performance audits on maintenance.

3.2 Selecting an audit problem

Identifying maintenance problems is easy in cases of a public outcry in newspapers, reports, Parliament debates etc. caused by poor service delivery. Performance auditors own observations or observations or information's from others can give indication of problems. The performance auditors can get information from regularity auditors. Sometimes problems are even highlighted by the auditee. In the cases when problems are highlighted by the auditee we can expect that measures have already been taken or are being planned for. Problems could also be identified when looking at activities indirectly related to maintenance. For example, a high number of roads accidents might be caused by inadequate maintenance, and poorly maintained office buildings could impact on the government entity's service delivery.

It should be pointed out that the shortcomings are often not limited to maintenance as such. Some problems discovered during an asset's operation might be caused by incidents at the time of construction, which in turn could have been affected by funding or planning. For these reasons it is helpful to use a process perspective when approaching maintenance problems and their causes.

Figure 2: Maintenance in relation to surrounding problems



It is important to consider the cost of maintenance when planning the investment in an asset. When assets are procured the resources for future maintenance cost needs to be taken into consideration. The economic life span of the asset before it should be replaced also needs to be calculated. Problems in the contracting and construction phases could thus affect the conditions for operations and maintenance. Auditing these aspects can be difficult and can merit an audit on its own. The auditors might include contracting and construction aspects together with maintenance issues in their audit.

Maintenance needs to be planned with set priorities based on needs assessment and estimations of future revenues. Complexity is added in cases when standards, systems and materials change over time. Furthermore maintenance of assets is increasingly contracted out to private firms, thus adding the features of tender and procurement of the maintenance. All these aspects have to be considered when auditors search for a suitable audit problem.

To ensure that a facility operates with desired output and quality, a number of key features have to be taken care of. Often maintenance problems are related to one or several of the following features:

- Workmanship and staff competence
- Equipment, machines and tools
- Material and spare parts
- Allocation of resources and staff
- Management
- Accountability and ownership
- Funding and financing

The problems can be interdependent. Auditors might find excellent maintenance plans and schemes at the auditee whereas implementation is weak. Staff who lack adequate skills cannot do a proper job no matter how advanced the equipment, and skilled staff cannot not repair facilities without the supply of spare parts. The problems brought up in the figure above can to a great extent be interconnected (see also the figure in appendix 1).

Management of maintenance

Well-functioning maintenance management systems play a significant role in reaching the activity's goals. Efficient maintenance work demands adequate and systematic means of planning, budgeting, monitoring and controlling. It is therefore wise to incorporate management aspects in an audit of maintenance issues. An adequate management system plays a vital role in ensuring efficient maintenance work.

The planning, budgeting, monitoring and control of maintenance activities on the strategic and operational levels should be available through documents. Essential documents that the auditee should have in place and up to date include among others:

- Policy, objectives and standards
- Manuals and operating/maintenance procedures
- Classification and assets inventory
- Assessment of maintenance needs
- Calculation of resource requirements
- Assessment of priorities and related funding
- Execution of works
- Monitoring of performance

Auditors should request the auditee to explain how different plans and activities, processes/procedures, and division of responsibilities between different players, interact in order to create a functioning system and desired output. Doing this, it will later be easier to connect efficiency or effectiveness problems to specified activities.

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Auditee's priorities and performance targets

The entity responsible for maintenance has to prioritize its activities based on needs. The needs assessment should be systematic and derived from relevant criteria and thresholds. Criteria include the anticipated life-span, the current condition of each asset as well as its number of users. The threshold should ideally be set to a value where further deterioration will cost users more than the cost to initiate the optimal maintenance action. The optimal maintenance action is the one which leads to the lowest life-cycle cost of the asset. Lack of routine and periodic maintenance leads to a higher cost for emergency maintenance or that the assets deteriorate. In practice, however, the schemes to maintain are often limited by funding. The funding may not increase until public outcry over the poor conditions is strong enough, which normally is too late, and the insufficient maintenance would cost society more than the cost to initiate maintenance at an earlier time. Therefore the auditee is responsible for urging for sufficient funding well in advance, with well supported arguments. Auditors should expect to find a coherent strategy, especially in situations when granted funding is scarce. For instance an auditee has to weigh the following options:

- Prioritise worst assets first, or
- Give preference to some activities by employing a rank ordered based on priority keys, or
- Lower maintenance standards in general.

Where does the problem occur?

To verify where in the chain performance has failed, it is important for auditors to define the functions and their responsibilities, for example:

- *Legislator and financier*: the ministry setting the legal and policy framework and allocating the funds.
- *Administrator*: the authority/agency responsible for implementing policies and for ensuring compliance with legislation and standards.
- *Manager*: the entity managing the activities needed to ensure long-term performance.
- *Designer*: the entity with specialised technical competence assisting the manager to specify the precise works needed.
- *Maintainer*: the entity carrying out the works specified by the manager.

Managing, designing and maintaining functions can be both public and private. They can be both in-house and contracted out. Often, private firms are used for the design due to technical skills in the particular field required. Their performance is a responsibility for the public entities responsible for the assets. The considerations regarding in-house and contracting out decisions can also be of interest to audit.

Contracting out maintenance work

Contracting (outsourcing) construction, operation and maintenance to private or public companies is becoming increasingly common. Careful consideration should be given to whether outsourcing would provide value for money. This can be an area of high risk to fraud/corruption and there may not be a well developed local market.

The auditee is however always accountable for the final outcome, even if the maintenance is contracted out. Adequate monitoring is essential to ensure the interests of the government and to keep costs down. It is important to know how maintenance is supervised, how frequently it is done, what level of expertise is used and consequences of non-fulfillment of the contract.

The contract terms may specify the time frame for the contractor to complete tasks, how to report on maintenance carried out, payments schedules, approval and certifying maintenance works done, penalty clauses for non-adherence to the contract terms, etc. Deviations versus fulfillment of terms in the contract may be important issues.

Contracted maintenance can have different arrangements:

- *Stipulated-sum*: The specified works are to be delivered at a fixed cost.
- *Unit-price*: A set of specified items or activities, with a volume assigned to each, is carried out and paid per unit when completed.
- *Performance-based*: An end result and end user oriented contract with less detailed and defined items and activities is to be delivered. Instead, the contract specifies performance and performance indicators that are perceivable and measureable.

The intention of performance-based contracts is to provide the contractor with more liberty regarding work and materials, to enable cost reductions at no expense to the owners. Performance-based contracts are more difficult to assess because the principal, i.e. the government entity, has less control. These contracts should include close follow up and well specified standard/output, how the end result is measured and the consequences if the end result is not met. It can be difficult to access private entities' records; however, auditors should expect to find the essential information and copies of documents at the auditee.

Contracting out maintenance can be made either before the construction phase, as part of the contract, or after finalisation of the asset.

As an example contracting out maintenance of roads is developed below.
Contracting out for specific items of road maintenance work, such as the resealing, overlay or reconstruction of a specific length of pavement are commonly used.

Routine and periodic maintenance operations are sometimes contracted out separately especially when there are more complex periodic activities, such as pavement or bridge repair work. Contractors can also be responsible for managing the maintenance and operation programs, including; performing routine inspections to identify needs, setting priorities and scheduling the work.

Contracting out road maintenance work requires an effective evaluation of contractors and their bids. If that is not done unacceptable bidders can distort the bidding process by excessive underbidding for contracts but not have the ability to complete the contract at a later stage. Key documents are:

- ❖ The Contract itself;
 - General Conditions of contract including information regarding contractor's responsibilities, schedule of completion, quality and cost control,
 - General specifications for roadwork, including all requirements that must be met during work execution, as well as penalties which will be applied when construction and maintenance specifications are not complied with;
 - Particular technical specifications and other specific requirements to be met during the execution of the various components of the contract:
 - Plans and drawings;
 - Various securities and guarantees bonds.
- ❖ General specifications for roadworks in use;
- ❖ Detailed reports on the actual condition of the road or network to be maintained, including a set of relevant maps and drawings;
- ❖ Environmental manual in use; and
- ❖ Standard unit costs applicable to emergency works such as transport of materials, hours of rent for equipment and specific maintenance crews, and ton or cubic meter of asphalt or concrete patching or other.

Activities in organisations or programmes can be audited

The situation in society that is not satisfactory may be defined as a problem from an auditees point of view, but from an auditor's perspective that is not an audit problem. Activities in organisations or programmes where performance is not satisfactory may be defined as audit problems.

The audit problem is determined by the selection criteria. Infrastructure assets are inherently associated with materiality of value as well as materiality of nature. Sudden breakdowns of facilities could directly affect people's life, e.g. if city inhabitants are not provided with fresh water the consequences are severe. Today's problems can be caused by poor maintenance in the past or poor maintenance today can lead to risks of breakdowns in future. It is worth pointing out that performance audits of maintenance can be motivated by the mere risk of undesired consequences from poor maintenance. It can be sufficient to highlight that potholes or flooded streets certainly increase the risk of road accidents.

In the pre-study the auditors should familiarise themselves with the specific type of assets and the auditees activities regarding those assets. This is essential in order to understand the characteristics of the maintenance that is needed.

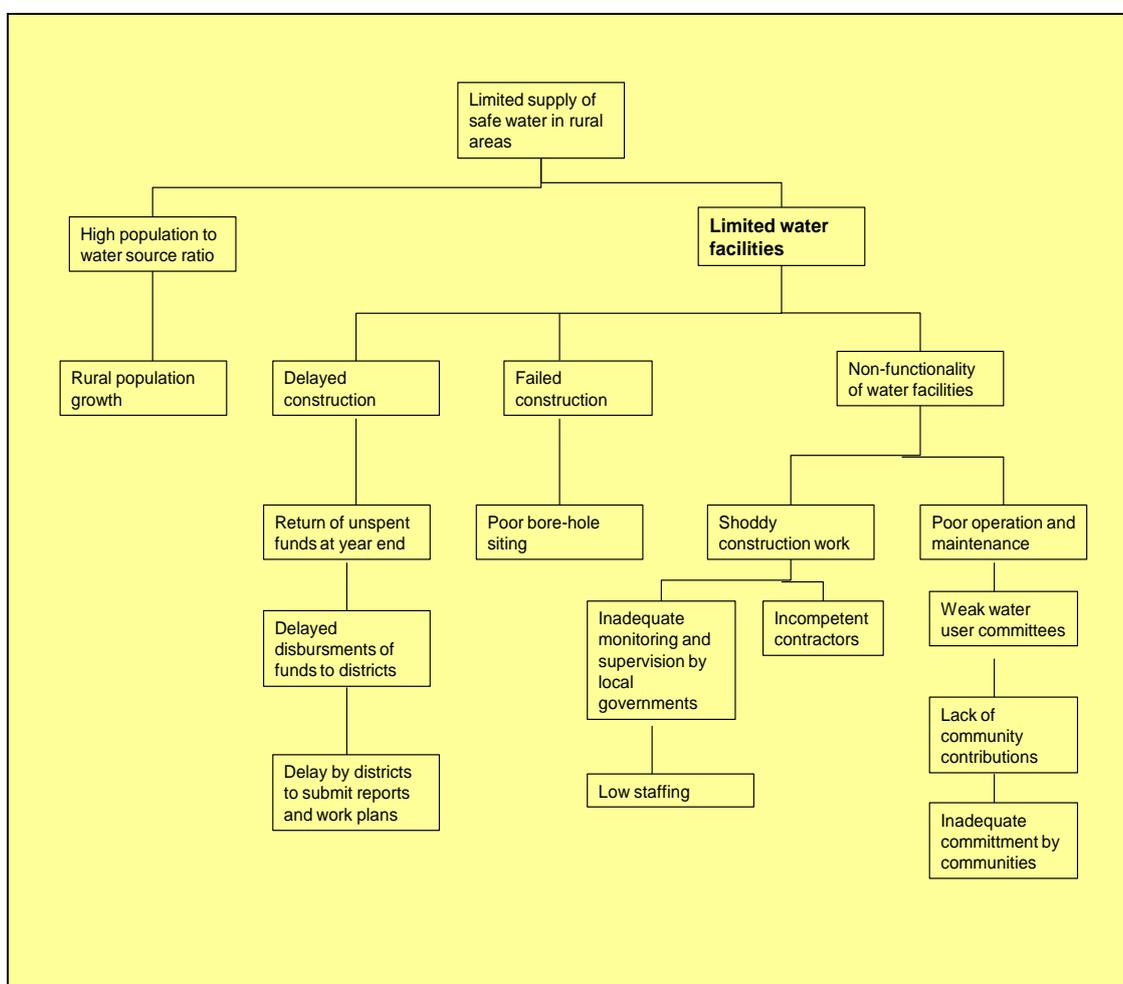
Some existing problems are not suitable audit problems because they are not easily auditable, e.g. "Are adequate and safe roads provided?". On the other hand some problems, e.g. "Is appropriate equipment used when maintaining the building?", can be too specific to address significant problems and the audit would not add significant potential for change.

The problem-tree technique

In the AFROSAI-E Performance Audit Manual there is a presentation of the problem-tree technique which is a tool to analyse the relationship between problems. It relates and links different problems to each other hierarchically according to how they influence each other. Any box in the tree can be identified as a problem. Causes of that problem will then be found as one moves downward in the tree and the consequences as one moves upward.

In the figure below we present an example of a problem-tree for performance auditing on maintenance of rural water supply. In our example the selected audit problem that was chosen was on a higher level than problems directly related to operation and maintenance. It also incorporated problems tied to the construction phase, making poor maintenance one of several explanatory factors to *limited water facilities*. Management issues such as funding, monitoring and control were included and addressed in the audit.

Figure 3: Example of a problem-tree, Provision of Water and Maintenance of Water Facilities (Uganda, 2009)



3.3 Audit objective, scope and audit questions

From the audit problem the audit objective is defined. The audit objective states the audit purpose and gives direction for planning the data collection, the report contents and developing audit findings. The audit objective should be precise in order to facilitate the formulation of audit questions.

Scope defines the focus and boundary of the audit (time, location, etc.). The scope will depend on how the responsibilities for different activities are divided among players, e.g. between the central level and local branches.

The audit questions have to be selected considering the audit scope. The number of audit questions will depend on the audit problem defined. It is, however, suggested that the audit questions be limited to five. When formulating audit questions, auditors are advised to ensure that each question to be raised in the audit is handled separately and, where questions are linked, there should be a clear indication of how they are linked.

Within performance audits of maintenance, the audit questions might aim at organisational and managerial problems as well as those concerned with actual maintenance work and its support systems. The examples presented below can be applied to audit questions of maintenance of all sorts of assets.

Audit questions related to economy

- Do the staff who carry out the maintenance work have the right qualifications?
- Was the contract designed to comprise defined requirements and output within a specified time to a stipulated cost?
- Was the maintenance that was contracted out done in the stipulated time and without cost-overruns? If not, why and what were the consequences?
- Are the adequate equipment and material available and handled competently?

Audit questions related to efficiency

- Does actual maintenance work meet with quality standards?
- Is response time to address call out duties reasonable?
- Does the auditee motivate its plans and priorities of work?
- Does the auditee have proper supervision instruments to detect inefficient work?
- Do maintenance activities secure that the assets are operational?

Audit questions related to effectiveness

- How does delay in addressing emergency maintenance affect the auditees customers?
- How is the asset's operational function (e.g. water supply) affected by lack of maintenance?

Example of audit questions.

Provision of water and maintenance of water facilities (Uganda, 2009).

In our problem-tree example of rural water supply, the auditee was the Directorate of Water Development under the Ministry of Water and Environment. The following audit questions were posed:

Q1: How is the delay in release of district water sanitation conditional grant affecting the construction of water facilities?

Q2: What is the effect of non-functionality of water facilities on the supply of safe water in rural areas?

Q3: How does the number of technical staff in the water department affect monitoring and supervision of water facilities?

Q4: What effect does non-involvement by communities have on maintenance of water facilities?

Q5: How does supervision and monitoring affect the quality of construction work?

3.4 Assessment criteria

Assessment criteria are the standards against which the performance of the audited entity will be measured. The assessment criteria differ in different audit questions.

Technical issues are often a crucial part of maintenance activities. Many maintenance standards are derived from engineering science and are internationally acknowledged or developed by the sector. Assets can have anticipated operational spans which determine the need for maintenance. For instance a specific truck engine should be maintained every 10 000 km and a particular kind of building is expected to need structural repair every 20th year.

The auditee might refer to in-house standards. In those cases the auditors should inquire from where those standards were adopted. The auditee should be able to motivate the selected standard for example by presenting references to best practice or benchmark. Auditors can, if possible, consult/interview some expert or any other authority outside the auditee to corroborate information from the auditee. Auditors should preferably identify and use internationally acknowledged standards, or at least standards recognised within the sector. Nonetheless, it can be a challenge to know how to apply standards of a technical nature. Some of the audit questions may also not be able to assess by technically well-recognised standards. The audit question shall govern the choice of assessment criteria. The auditors should consult and try to agree with the auditee on what standards that will be used in the audit to assess performance. Even if the assessment criteria's is discussed with the auditee it is important to underline that the auditors have the final choice in the selection of the assessment criteria. Securing a shared perception will avoid contention on the analysis and audit findings.

Keep in mind that.-

...maintenance standards might have changed since the facility was constructed and started to operate.

...different parts of a facility, e.g. separate roads within a city, might adhere to different standards, which affect their life expectancy and maintenance needs.

3.5 Approaches and methodology

General methods of data collection are applicable to audits of maintenance. The means of collecting documentary, testimonial and physical data are described in the AFROSAI-E Template Performance Audit Manual.

Methodology details the approaches in the work in evidence collection and analysis method (including comparisons and measurements). For example, if several districts/regions adhere to the same jurisdiction or maintenance schemes, the auditors might choose to compare different branches. Such comparisons could highlight deviations and provide reasons why some bodies are performing better than others.

The following paragraphs contain examples of audit evidence typically collected and compiled in performance audits of maintenance.

1. Measuring planning and monitoring

Measuring planning and monitoring is applicable when auditors measure the auditee's priorities and monitoring of the work. It can be useful if the auditee blames maintenance problems on the lack of resources. For management to monitor maintenance work and allocate resources to the most urgent activities, adequate systems need to be in place. Auditors would compare the auditee's plans and priority lists with the actual records and databases, thus determine whether the work carried out is based on a coherent strategy. The auditee's management will be assessed on whether the necessary steps were taken to ensure that the desired quality was achieved.

Example Maintenance of Roads (Botswana, 2008)

The auditors inspected the roads database procedures at the Roads Department, the entity responsible for maintenance. The database should serve as a tool for subsequent planning and inspection to be in line with the overall maintenance strategy and plan.

The auditors found that from the existing files it was not possible to determine a road's expected life span, since the database did not comprise basic features such as road class, surface type and traffic flow or records of previous maintenance activities.

Accordingly, the auditors concluded that the absence of an updated road database hampered management's priorities, impeded efficiency and increased the long run maintenance costs.

2. Calculate time or costs

By using this approach auditors measure and calculate maintenance productivity and identify bottlenecks in a system. A method is that the auditors will scrutinise the officer's report after that they have carried out certain maintenance tasks. From the officer's report sheet the auditors determine at what time the officer was at the venue, the time spent there and what kind of job was done. By scrutinising and categorising a number of officers' reports, the auditors calculate the time spent on different maintenance activities, for instance how many replacements or checks are done within a certain time frame or at a certain cost. If there are differences in output over time or between districts, the auditors would try to determine the underlying causes. Auditors should however not attempt to validate the quality of the work performed if they are not technical experts.

Example; Distribution of Water to Urban Areas (Uganda, 2009)

Customers of urban water in Kampala report on leaks and bursts to the responsible entity for it to conduct emergency maintenance work. The auditors used the entity's records of work to compute the average response time. Process:

1. The auditors reviewed the criteria/standard set by the asset company in terms of hours.
2. There were two systems of recording customer complaints on leakages or bursts: a call-in system (telephone) recorded complaints using software and a manual system where complaints were recorded in a book.
3. Auditors extracted complaints of technical nature like bursts and leakages for the period identified.
4. Data was arranged and analysed to come up with the actual average response time.
5. The results obtained were compared with the set standard where deviations were noted and raised as audit findings. Where set targets were achieved, that was also noted as good performance in the findings.

Shortage of repair material due to a centralised procurement system was identified as the main cause for the long response time.

3. Determine the work flow

This approach can be applied to identify bottlenecks in a maintenance process involving several stages and workmanship. The activities carried out can be mapped using the flow-chart technique or they can be mapped out in a table. The mapping illustrates the activities, time spent and output during different stages in the process. It also identifies the division of responsibilities between different players.

Example; Maintenance of Government Vehicles (Botswana, 2007)

The auditors used work-flow charts to map the different players and stages in the process of repairing and maintaining a government vehicle.

Separate flow charts were made for the different maintenance processes, e.g. accident inspection, parts ordering and subcontracting. Documents such as monthly workshop activity summaries, reporting structure, establishment register, requisition forms and purchase orders were examined. By mapping the processes in flow charts the auditors, through further investigation, identified bottlenecks in the auditee's maintenance processes. The auditors later concluded that the main problem was delays in restocking of spare parts.

4. Measuring an asset's functionality

Valid data to assess functionality of an asset may not be available. In cases where the auditee cannot present updated or reliable information about the status of assets, auditors can assess the current status by inspecting the physical objects. This approach is applicable when functionality can be spotted and determined by auditors without expert competence. It can otherwise make it necessary to consider involving adequate expertise in the audit projects to do inspections or to advise how the auditor can determine the status of the asset.

Example; Water and Maintenance and Water Facilities in District Local governments (Uganda, 2009)

The audit assessed the government's operation of water facilities in rural areas. The auditee had developed goals regarding coverage and standards for monitoring, hence the auditors focused on the system's functionality and maintenance by inspecting the status of water facilities in villages.

The audit revealed that out of 144 water facilities inspected, 45 % were not functional.

The auditors identified the key factors affecting functionality as lack of repairs and poor quality of construction work.

The auditors identified underlying causes, of which the most important were lack of ownership and supervision, staffing gaps and non-availability of spare parts.

Physical inspections can be documented by photos to use as audit evidence. Photographic evidence can corroborate evidence retrieved from documents or interviews.

Example. Management of Police Residential Accommodation (Ghana, 2008)

The accommodation of police officers in Ghana is provided for by the government. A certain department within government is responsible for managing and maintaining the facilities.

In the audit the auditors used pictures of police residences to illustrate the poor condition of the facilities. Moreover the pictures visualised the problem of overcrowding, including pictures of officers who had to use the same bed. Besides concluding that maintenance was deprived, the auditors raised a concern about whether the poor accommodation conditions impacted negatively on the officers' morale and work ability.

5. Stakeholder surveys

A survey could serve as audit evidence in cases when there are defined stakeholders, most likely users, with experience from the service provided. A survey adds primary source data and is collected independently from the auditee. The auditors have to be careful when interpreting and using the results, since the stakeholders experience can be affected by many other things than the service in question.

Example: Maintenance of Urban Water Supply (Botswana, 2004)

In the urban water supply audit a questionnaire was distributed to customers.

Customers were asked about the

- frequency of network breakdown and water shortage
- the auditee's response time to complaints
- repair time of meters
- operational staff's equipment and expertise
- if the auditee's gave prior notice before planned stoppage of water supply
- overall satisfaction with maintenance service.

The survey revealed that customer complaints were not addressed as fast as stated by the auditee (up to 30 days instead of the stipulated 20 days). Furthermore, the survey highlighted that about one third of the customers were not satisfied with the maintenance work.

The survey findings were considered useful by the auditee's management (as commented by management in the audit report).

4 Experiences from SAI's in the region

In this chapter experiences and lesson learnt from performance audits of different types of maintenance issues done by SAI's in the region are presented.

4.1 Experience from audits of different types of assets

The preconditions for performance audits of maintenance might differ depending on the type of asset. In this sub-chapter we provide experiences from different performance audits regarding maintenance of buildings, roads, water supply and vehicles, respectively. They refer to performance audits of maintenance conducted mainly by the SAIs of Botswana, Ghana and Uganda.

Buildings

Audits focused on buildings used by government ministries, agencies or other entities. The buildings could be used as offices, service buildings (e.g. hospitals) or to accommodate officers. The buildings could be owned by government or rented from a private landlord.

Experience from audits

- Auditee sometimes prioritise surface maintenance instead of structural repair, the building would decay in the long run. Therefore be aware of the distinction between restoration and renovation.
- In cases where buildings are rented it is helpful to incorporate the views of landlords.
- Buildings without revenue or occupied by less influential tenants are at risk of receiving less maintenance.
- The cost of maintenance work as compared to the cost of a new building can be computed.

Roads

Provision of adequate road networks is considered a strategic mean in poverty alleviation.

Environment is seldom taken into account in the design and implementation of road maintenance tasks. Environmental consideration should be included in road maintenance programs and could be audited from methodological, technical, economical and institutional/contractual points of view.

The performance audits have focused on the maintenance of roads within a certain district.

Experiences from audits

- Routine and periodic maintenance is important since they are relatively focused on minimising the effects of future natural disasters (e.g. floods) and accidents, thus indirectly decreasing the need for emergency maintenance.
- Separate kinds of roads might adhere to different standards, thus they have different life expectancy, which affects maintenance needs.
- Responsible entities tend to expand the road network instead of maintaining existing roads, so in the long run all roads decay.
- The road maintenance budget is helpful when auditors need to identify frequently maintained roads.

Water supply

The provision of safe drinking water is a fundamental function in people's life.

Because the provision of rural and urban water deals with different setups and challenges, they merited separate approaches and audits.

Urban water was distributed through pipe systems and managed by an agency or company billing customers.

Rural water was distributed via pumps for free and should be managed by the users themselves. In the rural case the auditee's primary role was not to operate and manage the system, but rather to make sure that clients have the knowledge and equipment to operate and maintain the facilities themselves.

Experiences from audits on urban water supply

- It was important to include the commercial aspects aside from the technical issues, since revenue and customer satisfaction will determine the resources available for maintenance.
- Even a small improvement in the non-revenue water ratio can save a lot of resources.
- Water shortage was caused by leakages and bursts, illegal connections, under-registering meters, old distribution networks, water used for fire fighting.

Experiences from audits on rural water supply

- The district local governments had not secured the local communities' capacity and engagement. The lack of ownership and insufficient training of users resulted in the water pumps not being maintained and people turning to other (unsafe) water sources.
- Hand pump spare outlets in various regions were not operational, making it difficult to carry out repairs on water facilities. Furthermore there was a lack of standardisation in procurement of spare parts for water pumps, hence spare parts were not available.
- The non-functionality of water facilities was mainly due to inadequate supervision and monitoring.

Vehicles

Government cars, buses and other vehicles need proper maintenance in order to operate and deliver services. It is important among other issues to consider if the auditee have or do the following:

- An adequate record-keeping system. The system should track maintenance, repairs and inspections.
- Schedule periodic inspection and maintenance activities. Does the auditee have guidelines and checklists for preventive maintenance procedures?
- Have a method for determining when the wear of a component indicates that it should be replaced or repaired.

- Ensured that preventive maintenance and inspection program checks vehicle components whose deterioration directly affects vehicle control: braking system; steering system; couplers; tires and wheels; suspension.
- Developed guidelines to be used in placing vehicles out of service until necessary repairs are made. Determined how those guidelines will be enforced.
- Developed a way of gauging the effectiveness of their preventive maintenance procedures.
- Ensured that vehicles pass the minimum periodic inspection standards set out by the government (Motor or Equipment Safety Regulations). Does the auditee have guidelines and checklist for vehicle inspection?
- Trained drivers to detect maintenance and repair needs, and to report them.
- Have the auditee made provision for checking the condition of those components which cannot be easily detected by drivers.
- Ensured that mechanics and maintenance supervisors are adequately trained.

Be aware, that if vehicles are constantly in need of repair, that could be an indicator of inadequate maintenance and inspection.

The audit scope and methodology applied have great similarities with the methodology of infrastructure assets.

Experiences from audits

- Emergency maintenance is often the focus of the audit since it can be time-consuming and expensive, e.g. demanding rapid supply of spare parts for the vehicle to be operable.
- Emergency maintenance can be divided into structural repairs (i.e. the vehicle's body structure) and mechanical fault repairs (i.e. breakdown or failure of the vehicle's engine, breaks or other components).
- Different kinds of vehicles might have different needs and preconditions. For instance, new cars require other attention than old cars, buses have other needs than cars, and different brands have different chains of spare parts supply. This has to be considered when the outputs of different local branches/workshops are compared.
- The condition of the terrain is a key factor when determining the specification of vehicles.

4.2 Findings and conclusions on maintenance

Performance audits on maintenance within the AFROSAI-E region have dealt with a variety of problems. The following is a compilation of findings and conclusions from a number of those audit reports. The compilation aims at inspiring auditors who plan to do performance audits on maintenance.

Findings related to economy

- The vast majority of resources were spent on the construction of new assets, whereas a higher proportional share should have been allocated to maintenance in order to keep assets operable.
- The collection of revenues was non-functional.

Findings related to efficiency

- Long response time to emergency maintenance.
- Determination of restocking spare parts was not based on needs analysis, but on intuition, hence it caused supply shortage.
- Centralised procurement system and slow distribution systems caused shortage of repair materials.

- Staff did not receive product training, hence had not enough technical competence. This forced the auditee to contract out minor maintenance works which caused unnecessary delays and higher costs.
- Inspectors did not carry out periodic inspections, e.g. visited and examined facilities, as they were supposed to do.
- Inappropriate methods and techniques used in maintenance works compromised the assets' structural firmness.
- Redundant equipment caused low morale among staff, thus low output.

Findings related to effectiveness

- Large number of uncompleted and abandoned projects (buildings) due to poor planning.
- Delays in connecting new customers created dissatisfaction.
- Wrong maintenance, e.g. surface instead of structural repairs.
- Maintenance was not successful in eradicating parasites in rural water systems.

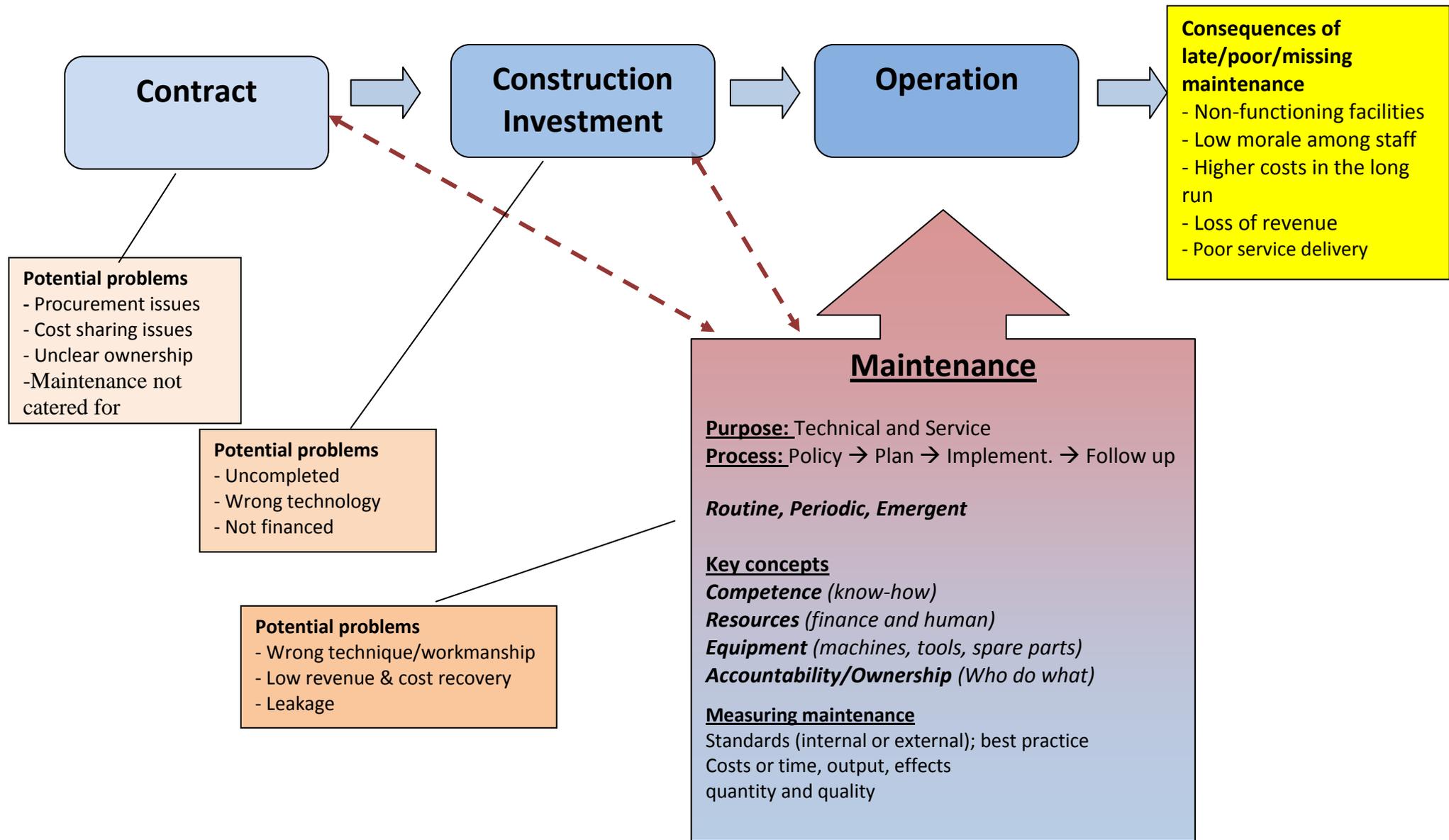
Findings related to maintenance management

- The auditee lacked maintenance strategies, plans, policies and guidelines which could act as guiding instruments for maintenance works. This hampered coordination of work and standardisation of working methods.
- Absence of maintenance performance targets meant that effectiveness cannot be confirmed. A schedule to measure maintenance performance did not exist.
- The auditee did not have, in accordance with best practice, a prescribed time frame for different maintenance activities.
- Poor supervision and monitoring disabled corrective action thus delaying emergency maintenance.
- Poor follow up and not updated record-keeping made it difficult for the auditee (and the auditors) to control the status of assets.
- Poor management of human resources caused shortage of skilled staff. The absence of technical expertise affected the working conditions.
- Poor coordination of work between ministries/departments within government hampered the maintenance.
- Regions/branches did not submit progress reports; therefore funds for maintenance were not released.
- Poor coordination and understanding between stakeholders due to limited sensitization, for instance roads construction was not coordinated with water facilities, telecom and cabling wires. Costs could have been shared with all stakeholders, thus lowered.

Findings related to contracting

- Unclear description of works in the contract made it difficult to assess performance and quality.
- Subcontracted maintenance was not monitored by inspectors.
- Contractor lacked the capacity to carry out the works.

Annexure 1: Maintenance in relation to surrounding problems



Maintenance of assets – Performance Audit Guidelines

One of the strategic imperatives of the African Organisation of English speaking Supreme Audit Institutions (AFROSAI-E) is to develop performance audit.

We have realised that it would be beneficial for our SAIs to have access to guidelines on audit problems often encountered by our SAIs. Consequently AFROSAI-E has decided to produce a series of guidelines of this type. These guidelines on maintenance are the second in this series and more guidelines will follow. We hope the guidelines will be useful when conducting performance audits on maintenance issues.

If you have feedback on these guidelines or if you want to suggest topics for future guidelines you are welcome to contact the

AFROSAI E Secretariat at

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You are also invited to visit our website

www.afrosai-e.org.za

where you will find information on performance audit in the region.